

Fact Sheet and Analysis **Economic Impacts of Harmful Algal Blooms Research Project**

Based on the research of news articles, journal articles, U.S. Congressional legislation, a presentation, and primary and secondary studies pertaining to harmful algal blooms and their economic impact on the Lake Erie coastline in Ohio, the figures below are based on actual or estimated economic impacts/losses. Unless stated otherwise, all data are for economic impacts experienced in the Ohio counties bordering Lake Erie. These counties include Lucas, Ottawa, Sandusky, Erie, Lorain, Cuyahoga, Lake, and Ashtabula. All amounts are adjusted to 2016 dollars using U.S. Consumer Price Index data.

The table below provides the high range and low range of economic impacts for each listed industry.

Affected Industry	Low Range of Economic Impact (in 2016 U.S. Dollars)	High Range of Economic Impact (in 2016 U.S. Dollars)
Overall Economic Activity	\$5,084,020,938 ¹ (Nationwide, annually); \$74,841,983 ² in 2011 event; \$65,102,962 ³ in 2014 event	
Sport Fishing	\$2,529,870 ⁴	\$21,000,000 ⁵
Commercial Fishing	\$5,000,000 ⁶	
Tourism	\$41,113,930 ⁷	\$110,000,000 ⁸
Beach Goers	\$25,774,999 ⁹	\$230,000,000 ¹⁰
Rental Properties and Real Estate	The results of the actual economic impacts are inconclusive.	
Personal/Recreational Boating	\$12,386,707 ¹¹	
Drinking Water Supply Protection	\$276,000 ¹²	\$64,000,000 ¹³
Federal Grant Funding	\$175,873,314 provided strictly for HAB remediation implementation and research ¹⁴	
State and City Funding	Over \$150,000,000 ¹⁵	
Health Care	Negligible ¹⁶	\$19,868 ¹⁷

Below are figures for values of each stated industry. All amounts are adjusted to 2016 dollars using U.S. Consumer Price Index data.

Affected Industry	Industry Value (in 2016 U.S. Dollars)
Sport Fishing	\$1,581,168,672 ¹⁸ for all of Lake Erie
Commercial Fishing	\$1,087,385,809 ¹⁹
Agricultural	\$1,214,086,021 ²⁰
Tourism	\$12,122,293,155
Rental Properties and Real Estate	\$3,458,000,000 ²¹ in private property value that could be impacted.
Recreational Boating	\$307,285,984 ²²
Chartered Boating	\$10,765,119 ²³
Shipping - Port Fees and Charges	\$817,496,651 ²⁴ at Port of Toledo

• Interesting Facts

- Eutrophication and HABs are conservatively estimated to cost the U.S. economy between \$2.2–4.6 billion annually (Hudnell, 2010);
- Lake Erie has approximately 2% of the Great Lakes water, but has over 50% of the fish most in demand such as walleye, yellow perch and bass;
- According to Davenport and Drake (2011), small businesses around the lake have lost \$37 million to \$47 million in revenues, and several local marinas and boat dealers have gone out of business;
- The total impact of ecosystem service interruptions due to the 2011 HAB event is found to cost roughly \$71 million (\$16 million for property value, \$20 million for tourism, \$31 million for recreation, and \$4 million for water treatment). For the 2014 HAB event, the estimate is roughly \$65 million (\$18 million for property value, \$20 million for tourism, \$23 million for recreation, and \$4 million for water treatment);
- Seiler et al. (2001) used a hedonic pricing model of homes near Cleveland, Ohio, and estimated that all else equal, houses that have a view of Lake Erie are an average of 56 percent more valuable than houses that do not have a view of Lake Erie;
- A 2014 report by the binational International Joint Commission (IJC) that studied algal blooms in Lake Erie, estimated between 24,000 and 210,000 properties could be affected by harmful algal blooms on Lake Erie;
- The Lake Erie seaports combined generate approximately \$1 billion in revenue each year (Kieser & Associates, 2008). These ports are so important that during the next 10 years, the U.S. and Canadian governments will commit close to \$1 billion to improve infrastructure and modernize navigation systems to improve transportation performance, reliability and create jobs (Marine Delivers, 2012);
- In 2011, the City of Toledo paid an extra \$3,000-\$4,000 per day this summer to prevent the toxic algae from getting into the city's water supply;

- Ohio ranks No. 18 in the U.S. for its boating activities, with more than \$306.8 million in total sales of new powerboats, engines, trailers and accessories;
- NOAA estimates harmful algae costs the U.S. economy \$82 million a year in losses incurred by the seafood and tourism industries.

Further Analysis: “Economic Benefits of Reducing Harmful Algal Blooms in Lake Erie” and “Algal Blooms: Estimating Costs to the Lake Erie Basin Economy”

There are two studies titled, “Economic Benefits of Reducing Harmful Algal Blooms in Lake Erie” and “Algal Blooms: Estimating Costs to the Lake Erie Basin Economy”, that measure the economic impacts using secondary data. Using this data, the authors were able to convey their findings and analysis in an in-depth format. Below are key findings and features from each study.

“Economic Benefits of Reducing Harmful Algal Blooms in Lake Erie”

• Analysis Approach

- Focused on the American/Ohio side of Lake Erie;
- Identify the economic benefits of reductions in future HABs and does so by evaluating the benefits of avoiding a recurrence of certain, previous HAB events like those in 2011 and 2014;
- Although the scenarios considered are based on past HAB events, these events are considered as they would occur in the future;
- This study relies on available secondary data and studies.

• Study’s Findings

Estimated Total Economic Costs <i>Business-as-Usual Scenario</i> 30-year net present value, 3% discount rate in 2015 dollars	
2011 HAB Event	\$1.463 billion
2014 HAB Event	\$1.339 billion

Estimated Economic Costs by Industry, 2015 dollars	
Property Values	<ul style="list-style-type: none"> • HABs causing a 5 percent impact to near-shore values and a 10 percent impact to shoreline properties would result in \$242.1 million in property value impacts • \$3.458 billion in residential housing stock that are located on the shore or in the nearshore (within 0.5 mile of the shoreline) of the western basin of Lake Erie.
Tourism	<ul style="list-style-type: none"> • Ohio tourism dollars at risk range from \$66 million to \$305 million. • Associated high-end lost profits are \$20.79 million, and low-end lost profits are \$165,000. • <u>Approach</u>: The approach used to assess tourism impacts in this report apportions aggregate estimates of tourism to identify tourism dollars that are at risk.
Recreation	<ul style="list-style-type: none"> • Quantified loss of benefits for beach-going are \$14 million for 2011, and \$11 million for 2014. • For fishing, the loss of benefits are estimated at \$10 million for 2011, and \$7 million for 2014. • For boating, the lost benefits are \$7 million for 2011, and \$5 million for 2014. • The overall benefits to recreation from the lack of a HAB event are \$31 million for 2011, and \$23 million for 2014.

Drinking Water Withdrawals	<ul style="list-style-type: none"> • According to Ohio EPA, \$3 million per year in costs related to ensuring a steady water supply, even during severe HAB events.
----------------------------	---

• Limitations of the Study

- Very little specific and useful data regarding Lake Erie-related tourism and the effects of HABs was available;
- Only a portion of the tourism occurs during prime, potential HAB time periods. However, it is clear that significant tourism revenue is at risk due to HABs;
- Certain information such as timing and severity of HABs at a micro-level (beach, marina, neighborhood, etc.) as well as short-run responses of people (such as recreators and/or tourists) and markets (rental, hotel, housing, restaurants) to the HABs are not available;
- Retaining generated profits from tourism would constitute a direct benefit to the value of businesses and commercial property;
- Did not directly link HABs to value of lost recreation. Benefits were derived by transferring information from related literature.

“Algal Blooms: Estimating Costs to the Lake Erie Basin Economy”

• Analysis Approach

- Focused on the Canadian side of Lake Erie;
- Represented economic costs using three scenarios: stable lake, business-as-usual, and policy intervention;
- Economic costs addressed in the project were estimated using a combination of market values and surrogate- and non-market estimates of economic value;
- The analytical period for the study (30 years) was determined based on the length of time required for substantial changes in ecological conditions to come to pass in the lake and the length of time required for economic conditions to react to changes in the lake’s ecology;
- All main variables were structured as probability density functions and built into a computational uncertainty analysis using Monte Carlo techniques;
- Utilizing e Monte Carlo model yielded a risk-based approach to allow for estimate confidence ranges and identify key uncertainties;
- Data was obtained from sources within Environment Canada, other federal and local government agencies, and peer-reviewed scientific and economic literature.

• Study’s Findings

Estimated Total Economic Costs			
30-year net present value, 3% discount rate in millions of dollars, 2015			
	Lower Bound	Central Estimate	Upper Bound
Stable Lake	1,680	2,788	3,206
Business-as-Usual	4,076	5,324	5,824
Policy Intervention	1,655	2,474	2,782

- *The stable lake cost estimates represent the 30-year NPV of the baseline (2015) costs. They reflect what costs would be if HABs were held constant at their 2015 level;*
- *In calculating these and the following NPV estimates, the data uses Environment Canada’s recommended discount rate of 3%, with 0% and 7% as lower and upper bounds*

Justification for Policy Intervention under a 30-year NPV Scenario

Policy intervention would be justified on economic grounds if the NPV of the costs to control algal blooms (as the blooms are specified in our scenarios) were less than \$1,294 million.” This estimate takes the difference of the lower bound Business-as-Usual figure and the upper bound Policy Intervention figure.

Estimated Total Economic Costs			
Equivalent Annual Cost, 3% discount rate in millions of dollars, 2015			
	Lower Bound	Central Estimate	Upper Bound
Stable Lake	86	142	164
Business-as-Usual	208	272	297
Policy Intervention	84	126	142

Justification for Policy Intervention under an Annual Cost Scenario

The difference between the central estimates under the Business-as-Usual scenario and the Policy Intervention scenario is \$145 million. In other words, Policy Intervention would be economically beneficial if the cost savings to implement HAB reduction activities was \$145 million or less.

Estimated Economic Impacts by Industry and Category			
30-year net present value, 3% discount rate in millions of dollars, 2015			
	Stable Lake	Business-as-Usual	Policy Intervention
Tourism	785	2,165	550
Non-users	1,452	1,849	1,357
Property owners	343	712	348
Recreational users	135	421	112
Commercial fishing	0	93	34
Water users	73	84	74
Human health	Not measurable (likely negligible)		

Justification²⁵ for Policy Intervention under a 30-Year NPV Scenario	
3% discount rate in millions of dollars, 2015	
Tourism	1,615
Non-users	492
Property owners	364
Recreational users	309
Commercial fishing	59
Water users	10
Human health	Likely Negligible

Estimated Economic Impacts by Industry and Category			
Equivalent Annual Cost, 3% discount rate in millions of dollars, 2015			
	Stable Lake	Business-as-Usual	Policy Intervention
Tourism	40	110	28
Non-users	74	94	69
Property owners	17	36	18
Recreational users	7	21	6

Commercial fishing	0	5	2
Water users	4	4	4
Human health	Not measurable (likely negligible)		

Justification²⁶ for Policy Intervention under an Annual Cost Scenario 3% discount rate in millions of dollars, 2015	
Tourism	82
Non-users	25
Property owners	18
Recreational users	15
Commercial fishing	3
Water users	0
Human health	Likely Negligible

• Limitations of the Study

- HABs and their economic costs remain only partially studied and understood;
- The accuracy of the cost estimates is not uniform across all categories;
- As with most modeling estimates, assumptions of data occur;
- Quality and confidences of cost estimates for the following categories/industries were below average or low: Commercial fishing, water users, and human health;
- The authors view the quality of the results as “acceptable”.

¹ “Conservatively” estimated for the entire U.S. economy.

² Estimated.

³ Estimated.

⁴ Estimated.

⁵ Central estimate of a 30-year net present value under a “business-as-usual” scenario.

⁶ Central estimate on an annual basis under a “business-as-usual” scenario.

⁷ Estimated.

⁸ Central estimate on an annual basis under a “business-as-usual” scenario.

⁹ Estimates based on the impacts from the 2011 and 2014 HAB events at 12 Lake Erie beaches in Ohio

¹⁰ Central estimate of a 30-year net present value under a “business-as-usual” scenario.

¹¹ Estimated at \$7 million for 2011 HAB event and \$5 million for 2014 HAB event.

¹² Estimated based on \$3,000 per day estimated costs in the summer (91.25 days, rounded to 92).

¹³ Estimated.

¹⁴ Actual, based on legislation signed in to law.

¹⁵ Actual.

¹⁶ Estimated.

¹⁷ Estimated and Actual. “The one reported case of illness in Ohio in 2011 related to harmful algal blooms had an economic value of \$2,128 and the estimated ten unreported cases had a combined economic value of \$16,720.

¹⁸ Estimated.

¹⁹ Estimated.

²⁰ Estimated value of crops.

²¹ Estimated value of shore-line and near shore residential properties

²² Actual. Based on total sales in 2013.

²³ Estimated revenue in 2010.

²⁴ Actual. Based on total value of cargo handled and income and consumption generated by the Port.

²⁵ For the given categories/industries, Policy Intervention is economically justified and beneficial if the costs to reduce HABs is less than or equal to the value of the difference between the Business-as-Usual scenario and the Policy Intervention scenario.

²⁶ For the given categories/industries, Policy Intervention is economically justified and beneficial if the costs to reduce HABs is less than or equal to the value of the difference between the Business-as-Usual scenario and the Policy Intervention scenario.